



## 4. Construction Phase

### Solution Life Cycle

Phases	Vision	Definition	Construction	Deployment	Support & Retirement
Results	Problem Assessment	System Requirements	Detailed Design	Deployed Solution	Production Services
	Solution Recommendation	Preliminary Design	Accepted Solution		

A summary of SLC recommendations to use during the Construction Phase is contained within the following matrix.

Phase Area	SLC Recommendations
<b>OBJECTIVE</b>	The objective of this phase is to develop and test an appropriate solution that meets the requirements defined in the Definition Phase, as well as the approved Business Case.
<b>ENTRY CRITERIA</b>	<ul style="list-style-type: none"> <li>• Solution Acquisition Plan has been updated.</li> <li>• Requirements Document has been developed, approved, and baselined.</li> <li>• Requirements Traceability Matrix is baselined.</li> <li>• Preliminary Design Document has been developed and approved.</li> <li>• SLC Security Checklist - Definition Phase has been completed and approved.</li> <li>• Quality Assurance Plan has been approved.</li> <li>• CM Plan has completed, approved, and baselined.</li> <li>• Configuration Item Index has been created.</li> <li>• Development environment has been established.</li> <li>• Critical Infrastructure Protection Program's Mission Essential Infrastructure Evaluation Survey is completed.</li> <li>• General Support System (GSS) &amp; Major Application (MA) Inventory Submission Form are completed.</li> <li>• TTS Plan has been reviewed and approved.</li> <li>• The Work Breakdown Structure has been updated.</li> </ul>



Phase Area	SLC Recommendations
<p><b>PROCESS AND OUTPUTS</b></p> <p>* Sample is provided in Appendix A</p>	<p><b><u>Solution Acquisition Planning (as needed)</u></b></p>
	<p><b><u>Solution Acquisition Project Management (ongoing)</u></b></p>
	<p><b><u>Requirements Development and Management</u></b></p> <ul style="list-style-type: none"> <li>Updated Requirements Traceability Matrix</li> </ul>
	<p><b><u>Detail Design</u></b></p> <ul style="list-style-type: none"> <li>Detailed Design Document</li> </ul>
	<p><b><u>System Security</u></b></p> <ul style="list-style-type: none"> <li>SLC Security Construction Phase Checklist</li> <li>System Security Plan</li> <li>Construction Phase Risk Assessment</li> </ul>
	<p><b><u>Build Solution</u></b></p> <ul style="list-style-type: none"> <li>Solution</li> </ul>
	<p><b><u>Solution Testing</u></b></p> <ul style="list-style-type: none"> <li>System Test Plans</li> <li>System Test Results</li> </ul>
	<p><b><u>Quality Assurance</u></b></p> <ul style="list-style-type: none"> <li>Memorandum of Records (MOR)</li> <li>Production Readiness Review (PRR)</li> </ul>
	<p><b><u>Configuration Management</u></b></p> <ul style="list-style-type: none"> <li>Updated Configuration Item Index</li> <li>CM Audit Findings</li> <li>Development CRs Submitted to Data Center</li> </ul>
	<p><b><u>Production Readiness Review (PRR)</u></b></p> <ul style="list-style-type: none"> <li>PRR Material</li> </ul>
	<p><b><u>Transition to Support Readiness Review</u></b></p> <ul style="list-style-type: none"> <li>TTS Readiness Review material</li> </ul>



Phase Area	SLC Recommendations
<b>ROLES AND RESPONSIBILITIES</b>	<p>The following roles will participate in this phase, and are defined in the Construction Roles and Responsibilities section:</p> <ul style="list-style-type: none"> <li>Chief Information Officer eCommerce Application Development (CIO ECAD)</li> <li>CIO IT Management</li> <li>CIO IT Services</li> <li>Configuration Management (CM) Lead</li> <li>Executive Sponsor</li> <li>Executive Steering Committee</li> <li>Integrated Product Team (IPT)</li> <li>Integrated Technical Representative</li> <li>Project Manager</li> <li>Quality Assurance (QA) Lead</li> <li>Requirements Development and Management (RDM) Lead</li> <li>Subject Matter Experts (SMEs)</li> <li>System Manager</li> <li>System Security Officer</li> <li>Technical Architecture Lead</li> <li>Transition to Support (TTS) Lead</li> </ul>



Phase Area	SLC Recommendations
<b>EXIT CRITERIA</b>	<p><b>The following are critical exit criteria for this phase:</b></p> <ul style="list-style-type: none"> <li>• The Requirements Traceability Matrix has been updated.</li> <li>• A Detailed Design Document has been developed and approved.</li> <li>• System Security Checklist - Construction Phase has been completed and approved.</li> <li>• Test Plans have been developed.</li> <li>• A developed and tested solution, including source, object, and execution code has been accepted.</li> <li>• PRR has been conducted and signed off.</li> <li>• The ECM migration to production CR has been scheduled.</li> <li>• Configuration Item Index has been updated and baselined.</li> <li>• Development CRs have been submitted to Data Center using ECM Tool.</li> <li>• PRR documentation has been submitted for posting to the Enterprise Repository.</li> <li>• Support Organization has been identified.</li> <li>• QA Reviews have been conducted as documented in the QA plan.</li> </ul> <p><b>The following are recommended exit criteria for this phase:</b></p> <ul style="list-style-type: none"> <li>• Construction Phase Risk Assessment has been completed.</li> <li>• CM Audit Findings have been addressed.</li> <li>• Develop the MOR.</li> <li>• TTS Readiness Review Material is developed.</li> </ul>
<b>JOB AIDS</b>	<p>PRR Checklist            Configuration Management Audit Checklist Template            CM File Repository Directory Structure Template            SLC Security Construction Phase Checklist            TTS Checklist            FSA Infrastructure Change Management Impact Analysis Worksheet            Enterprise Repository Process Guide</p>



### ***Construction Phase Objective***

The objective of this phase is to develop and test an appropriate solution that meets the requirements and acceptance criteria defined in the Definition Phase, as well as the approved Business Case.

The activities undertaken during the Construction Phase vary from project to project more so than in any other phase. The approach, tools, techniques, and deliverables will be determined in earlier strategy and tactical approach discussions and will be tailored to meet each specific solution. For example, the decision to develop and implement a custom solution, versus a COTS-based solution, or one involving an ASP, should be made before this phase begins. The processes and outputs documented in the Construction section and Deployment section of this Guide apply to IPTs that have made the decision to implement the solution via custom development or using COTS software. Implementing with an ASP will enable the IPT to skip the processes and outputs associated with the Construction and Deployment Phases of the SLC.

The Construction Phase is where the high-level design is further refined into a detailed design. This phase is where the team builds a solution that meets the approved requirements. The Construction Phase consists of detailed design, Construction and testing efforts, with the intent that the output of these efforts will meet the objectives as outlined in the Business Case. It is in this phase that the technical solution derived in the Definition Phase is implemented.

The following topics and processes will be addressed in this phase of the life cycle:

- Entry Criteria;
- Process and Outputs;
- Roles and Responsibilities;
- Exit Criteria; and
- Job Aids.

### ***Construction Phase Entry Criteria***

Before work in the Construction Phase can begin, the exit criteria from the Definition Phase must be completed. To review, these are:

- Solution Acquisition Plan has been updated.
- Requirements Document has been developed, approved, and baselined.
- Requirements Traceability Matrix is baselined.
- Preliminary Design Document has been developed and approved.
- SLC Security Checklist - Definition Phase has been completed and approved.
- Quality Assurance Plan has been approved.
- CM Plan has been completed, approved, and baselined.
- Configuration Item Index has been created.
- Development environment has been established.
- Critical Infrastructure Protection Program's Mission Essential Infrastructure Evaluation Survey is completed.
- General Support System (GSS) & Major Application (MA) Inventory Submission Form are completed.



- TTS Plan has been reviewed and approved.

### ***Construction Phase Process and Outputs***

The following paragraphs discuss the major processes to be completed during the Construction Phase, as well as the outputs of this phase.

Solution Acquisition Planning is conducted as needed as discussed in the Vision Phase and Definition Phases. Solution Acquisition Project Management is ongoing, and status reporting, risks and issues tracking continue as discussed in the Vision and Definition Phases. Additionally, the Requirements Traceability Matrix is updated. The Detail Test Plan is created.

#### **Detailed Design**

The Detailed Design Document should provide enough information in order for the solution to be thoroughly developed. The Architecture Working Group (AWG) will be involved in the review process; therefore, the designs must also be able to convey conformity to the FSA Technical Architecture standards. *For sample Detailed Design Document, see Appendix A.* The Detailed Design Document should build upon the Preliminary Design Document. The IPT WBS will be tailored to identify the specific documents and may include the following:

- **Program/Screen/Reports Design** - describes the exact detailed configuration of the computer program. It consists of descriptions of the processing logic, data structures, data definitions, screen or report layouts (where applicable) and is sufficiently detailed so that it can be implemented into a solution;
- **Interface Design** - provides the specific details of the user interface, including dialogs or conversations, window screens or pages, forms, reports, and possibly user interface hardware (monitors, input devices);
- **Development Architecture Design** – builds on the system architecture diagrams from the Preliminary Design Document, providing the detail needed to construct the solution development architecture, such as hardware, software, access methods, and protocols used. The design specification further outlines actual sites, minimum configuration requirements, and site requirements (size, power, temperature, etc.);
- **Execution Architecture Design** – builds on the system architecture diagrams from the Preliminary Design Document, providing the detail needed to construct the solution execution (run-time) architecture, such as hardware, software, access methods, and protocols used. The design specification further outlines actual sites, minimum configuration requirements, and site requirements (size, power, temperature, etc.);
- **Operations Architecture Design** - builds on the system architecture diagrams from the Preliminary Design Document, providing the detail needed to support operation of the solution in an efficient manner;
- **Physical Infrastructure Design** - builds on the system architecture diagrams from the Preliminary Design Document, providing detailed diagrams, interface standards, protocols, and so forth to support the physical network and computing components. The detailed design should provide adequate information on how to configure and install the physical network and computing components;
- **Human Performance Design** – design the programs needed to evaluate, compensate, develop, and recruit personnel for the solution;



- **Physical Data Model Design** - provides the information and code needed to create or generate the solution database. It builds on the Logical Data Models defined in the Preliminary Design Document; and
- **Security Design** – provides detailed information on security requirements relating to facility, physical access, system access, administrative privileges, sensitive and mission-critical operations, site-specific practices, and other matters.

One technique to facilitate effective review of the Detailed Design Document is through a Critical Design Review (CDR). This formal review should cover the entire Detailed Design Document from beginning to end. This comprehensive walkthrough gives the IPT and the Executive Sponsor the opportunity to develop a common understanding of the detailed solution design and to resolve any outstanding issues. Sign-off must be obtained from the Executive Sponsor before exiting this phase.

### System Security

The Construction Phase contains numerous security activities. A large portion of these activities is dedicated to documentation. To complete the System Security Plan, see the System Security Process Guide.

Additionally, at the end of the Construction Phase, the SLC Construction Phase Checklist should be signed off by the SSO. The checklist represents the completion of all security related activities for the Construction Phase. The activities include:

- Draft System Security Plan
- Draft Continuity of Operation Plan
- Draft Disaster Recovery Plan
- Draft System Security Authorization Agreement
- Threat Analysis
- Impact Analysis
- Risk Assessment Corrective Action Plan
- Final MEMORANDUM OF UNDERSTANDING (MOU)/SERVICE LEVEL AGREEMENT (SLA)
- Completed User Background Investigation Clearance Form
- Approved User Access Request Form
- System Access Letter to Contractor Employees

*For more information regarding the SLC Security Construction Phase Checklist, see the System Security Process Guide.*



### **Build Solution**

The solution is constructed by transforming the design to meet the requirements outlined in the Business Case. During this transformation from design, the application will be developed, tested and accepted by FSA prior to implementation, or deployment into production. For applications requiring custom development, this will entail writing code, while for applications utilizing a COTS product; modifications to the COTS product may be required. Appendix A contains information relating to Internet development standards, but for more discussion on FSA software development practices and standards, refer to the *FSA CIO Information Technology Handbook*.

### **Solution Testing**

Once the solution has been developed, it is the responsibility of the IPT to test the application to ensure that the solution satisfies the defined functional, technical, and quality requirements. Refer to the *FSA System Integration and Testing Process Handbook* for the testing standards, procedures, templates and management guidelines used during testing. The first step in the testing process is the development of the test plans that were identified in the Testing Strategy of the Preliminary Design Document. Test plans should document all activities required to conduct thorough and accurate tests of system parameters, customizations, interface modules, and business processes.

The IPT is responsible for planning, preparing/developing, and executing each test plan. At this step, the test conditions, cycles, and scenarios should be identified, and individual responsibilities specified relating to the development and execution of the tests. Planning the tests also includes locating and inspecting all the documents, information, and infrastructure (e.g. hardware and software testing tools) necessary to design, develop, and execute the test plan. The test planning for each level is described as follows:

- **Unit Test Plan** – This document defines common testing conditions, outlines the approach for executing the unit test, and describes the process and tasks to the developer;
- **Integration Test Plan** – This document defines the approach for executing the integration test, details the integration test objective, assumptions, and potential risk. The plan should also detail the necessary resources and test requirements;
- **Systems Test Plan** – This document defines the approach for executing the systems test, and details the objective, assumptions, and potential risk. Also included in the test plan are the test requirements and the test resources;
- **Performance Test Plan** – This document defines the approach for executing the performance test, and details the objective, assumptions, and potential risk. Also included in the test plan are the test requirements and the test resources. The test plan will detail how to simulate large transaction volume and critical response time areas to be tested; and
- **User Acceptance Test Plan** – This document defines the approach for executing user acceptance test, and details the objective, assumptions, and potential risk. Also included in the test plan are the test requirements and the test resources. *Appendix A contains a sample User Acceptance Test Plan.*

During test planning, it is important to identify all possible scenarios that could affect the way the application will behave. These scenarios can be as detailed as applicable, depending on the time and abilities of the application/system being tested. Test scripts provide a description of inputs, execution





instructions, and expected results created to determine if a specific application software feature functions correctly or if a specific requirement was satisfied. Unit, system, and integration test scripts rely on the design of the code in addition to the requirements and are initially developed during detailed design as part of the test strategy. Test scripts are continuously updated, as design and code are refined during the Construction Phase. The test script process for each level of testing is described below:

- **Unit Test Scripts** – Unit test scripts are based on knowledge of how the logical unit is designed to work and can be written once the detailed design specifications are completed. Each script includes tests for field ranges, values and lengths, each function, data validation, data dependencies, and special processing contained in the module. The unit test scripts should be updated as changes occur to the requirements and/or the detailed design specifications either before coding starts or while it is in process. The developer responsible for the module will run the unit test for that module. At the end of the unit test, all errors related to the independent operation of the program should be found;
- **Integration Test Scripts** – While the unit test scripts focus on the smallest logical unit or module of code, the integration test scripts focus on how multiple components work together and communicate. The integration test scripts describe test cases for the interfaces and interactions between system components as they are put together to form progressively larger subsystems. Integration test scripts also test the screens together as a cohesive information function, and then are built upon to test how the information function integrates with other functions in the system. By the end of integration test, all functions will be integrated into the system and all internal interfaces will be tested;
- **System Test Scripts** – The system test scripts expand on the high-level test scenarios and scripts developed during high-level design. The testers can reuse relevant test scenarios and conditions from the unit and integration test scripts;
- **Performance Test Scripts** – The performance test scripts expand on the high-level test scenarios and scripts developed during high-level design. These scripts detail the steps necessary to fully ensure that the deployed solution will be able to handle the expected workload and adequately address the business objectives stated in the Business Case and Business Performance Targets stated in the Business Performance Model; and
- **User Acceptance Test Scripts** – User acceptance test scripts expand on the high-level test scenarios and scripts developed during high-level design. User acceptance test scripts test the requirements from a user perspective. They include enough test conditions to determine if the application meets the user acceptance criteria.

In developing and documenting the testing approach, FSA advocates the use of the standard tool to assist in the tracking of requirements and verification that the solution meets the requirements. This will aid in resolving Software Investigation Requests (SIR), as original requirements can be quickly tracked. For more information on standard tools, refer to the Information Technology Handbook.

Once these tests have been successfully executed by the IPT, the Test Results should be documented that clearly indicate the testing procedures, data used during the testing processes and results demonstrating that the application meets the business objectives as stated in the Business Case and meets the performance targets as stated in the Business Performance Model.

### **Quality Assurance (QA)**

Quality Assurance continues from the Vision Phase. The QA Plan is completed and approved and QA reviews are conducted to verify adherence to plan standards and processes. The organization FSA QA



Team representative(s) evaluates activities and work products for compliance with applicable procedures, standards, and policies, as well as, completeness, consistency, appropriateness and applicability.

### **Configuration Management (CM)**

The CM Lead works with CIO ECAD to ensure a CM audit is conducted and findings are addressed. CM artifacts should match the CM Item Index and be placed into the CM Library.

CR Impact Analysis is performed and Development CRs are submitted to Data Center.

### **Production Readiness Review (PRR)**

The PRR is a common process that defines the activities and the roles of all IT groups supporting the decision to implement a production application. *For checklist to aid in the preparation for the PRR, See Appendix A.*

The objectives of the PRR are as follows:

- Review performance compared to anticipated value and success measures;
- Review converted data; and
- Assess the readiness of technology infrastructure.

At the conclusion of the PRR, the developing project follows the FSA Enterprise Repository Process to submit the documentation used in the PRR for posting to the Enterprise Repository (Asset Library).

Due to the complex nature of an application being moved into production, the migration CR should be submitted to the ECM Tool at least 21 days before scheduled release date. The Project Manager should coordinate the migration plan with the Data Center. The migration to production ECM CR must be submitted to the Data Center before the PRR is conducted.

Once the PRR has been completed, the solution is ready to be deployed and turned over to the Support Organization. For more information on the activities associated with the PRR, refer to the *PRR Procedures Guide* in the *Information Technology Handbook*.



### Transition to Support (TTS)

The TTS Readiness Material is developed. The purpose of TTS is to provide detailed knowledge of the solution and its artifacts in order to prepare a TTS Readiness Review. The TTS Readiness Review is conducted to provide a more comprehensive review in terms of readiness of the support organization. The Readiness Review enables the FSA TTS Lead to further evaluate the capacity and capability of the support organization and readiness of the solution documentation. *For more information, see the Transition To Support Process Guide.*

### *Construction Phase Roles and Responsibilities*

The following matrix is provided as a guide to the roles and responsibilities of the key personnel that are in the Construction Phase of the life cycle.

Title	Role	Responsibility
<b>CIO ECAD</b>	Liaison between the FSA QA Team and the Project Team.	Conduct reviews to ensure compliance to the SLC Process Guide and FSA QA standards. Act as liaison between the FSA QA Team and the Project Team. Support Project to meet quality standards and guidelines. Recommend CIO sign-off for the PRR.
<b>CIO IT MANAGEMENT</b>	Liaison between the Architecture Working Group (AWG) and the IPT.	Review the content within the Detail Design Documents to ensure they meet the Technical Architecture standards. Review and any hardware, software, integration, and system architecture needs or procurements in support of the AWG.
<b>CIO IT SERVICES</b>	Liaison between the VDC and the IPT.	Review the Requirements and Preliminary Design documents and work with IPT to identify needed VDC services. Notify the VDC of any planning changes identified during this phase.
<b>CM LEAD</b>	Manage project CM activities.	Conduct the CM Audit and report the findings. Update and baseline the Configuration Item Index. Ensure that PRR Documentation is submitted for posting to the Enterprise Repository



Title	Role	Responsibility
<b>EXECUTIVE SPONSOR</b>	Solution Sponsor.	Review and approve Detail Design Document. Also, review and approve any changes made to the Business Performance Model, Solution Acquisition Plan, Business Case and Task Order. Sign off on the PRR.
<b>EXECUTIVE STEERING COMMITTEE</b>	Project Review and Recommendations.	Responsible for reviews and recommendations made throughout the delivery of the solution.
<b>IPT</b>	Solution Development and Delivery Team.	Design, build, and test solution. Support the QA, CM, Security and TTS activities. Prepare for PRR.
<b>ITR</b>	Liaison between contractors and Business Channels.	Review the Detail Design Documents to ensure they meet the objectives as stated in the Business Case and the Business Performance Model, and make appropriate recommendations.
<b>PROJECT MANAGER</b>	Plan and manage the acquisition project	Implement and manage IPT and project in accordance with the Solution Acquisition Plan. Schedule and conduct PRR.
<b>QA Lead</b>	Plan and manage QA reviews.	Ensure that the project is performing all necessary QA activities as defined in the QA Plan. Act as liaison between the FSA QA Team and the project team, and make QA recommendations for the PRR.
<b>RDM LEAD</b>	Manage and control changes to solution requirements.	Monitor, trace, and report on requirement CRs. Coordinate communications between project team and User Representatives regarding system requirements. Manage the RDM processes. Update the Traceability Matrix.
<b>SMEs – FSA, EXTERNAL, CONSULTANTS</b>	Provide input to the Detail Design.	Assist in the definition and development of the Requirements and Detail Design Documents by providing solution-related expertise.



Title	Role	Responsibility
<b>SYSTEM MANAGER</b>	Manage, review, and make recommendations.	Work with the Project Manager and System Security Officer to ensure security meets the FSA's security requirements. Sign off on the SLC Security Construction Phase Checklist.
<b>SYSTEM SECURITY OFFICER</b>	Review and make security recommendations.	Work with the Project Manager, System Manager, and others to ensure that the solution requirements Detail Design meets the FSA's security requirements. Sign off on the SLC Security Construction Phase Checklist.
<b>TECHNICAL ARCHITECTURE LEAD</b>	Manage CR activity	Ensure CR Impact Analysis is performed and Development CRs are submitted to Data Center
<b>TTS LEAD</b>	Manage the transition preparation process.	Ensure the support organization is identified; manage the preparation of TTS Readiness Review.

### *Construction Phase Exit Criteria*

In the Construction Phase, the development of the detailed design and how this detailed design built upon on the Preliminary Design and traced back to the Requirements Document and the Business Case was discussed. The Requirements traceability matrix was used as the trace back process. The Construction and testing of the solution was also discussed. The PRR process was mentioned as a last step in the Construction Phase to be completed prior to the implementation of the solution.

Prior to the completion of the Construction Phase, the following exit criteria must be met:

#### **Critical:**

- The Requirements Traceability Matrix is updated.
- A Detailed Design Document has been developed and approved.
- System Security Checklist - Construction Phase has been completed and approved.
- Test Plans have been developed.
- A developed and tested solution, including source, object, and execution code has been accepted.
- PRR has been conducted and signed off.
- The ECM migration to production CR has been scheduled.
- Configuration Item Index has been updated and baselined
- Development CRs have been submitted to Data Center using ECM Tool.
- PRR documentation has been submitted for posting to the Enterprise Repository.
- Support Organization has been identified.
- QA Reviews have been conducted as documented in the QA plan.



**Recommended:**

- Construction Phase Risk Assessment has been completed.
- Test Results have been developed.
- CM Audit Findings have been addressed.
- Develop the MOR.
- TTS Readiness Review Material is developed.

***Construction Phase Job Aids***

The following job aids are available in the Process Guides:

- PRR Checklist
- Configuration Management Audit Checklist Template
- SLC Security Construction Phase Checklist
- TTS Checklist
- FSA Infrastructure Change Management Impact Analysis Worksheet
- Enterprise Repository Process Guide